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(54) **Method of error estimation in information data transmission**

(57) Method of error estimation in information data transmission in a communications system that comprises at least one transmitting means for transmitting said data to at least one receiving means, said transmission being effected by means of data forward bearers from said transmitting means to said receiving means. The receiving means normally send data reception acknowledgement messages via a reverse bearer from said receiving means to said transmitting means. The method is characterised in that the transmitting means estimate, by means of an estimation algorithm, the most probable error situation in the forward bearers in the absence of said data reception acknowledgement message.

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vented in the forward direction due to the presence of a transmission error on the reverse bearer.

DESCRIPTION OF THE INVENTION

5 · [0016] To overcome the problems above mentioned, the method of error estimation in information data transmission has been proposed, together with a transmitter for carrying out said method, both being objects of the present invention.
[0017] According to the method of the invention, the automatic repeat request procedure of the DECT transmitter is altered in the case where errors are produced in the reverse bearer, with respect to that presently established in the standard.

10 [0018] To this end, the transmitter is permitted to evaluate, by means of an intelligent algorithm, the most probable error situation on the forward bearers. Said estimation is made in the absence of the acknowledgement message transmitted on the reverse bearer. Depending on the result of the estimation based on said algorithm, the transmitter decides to continue with the transmission of new data in a normal manner or to retransmit each bearer in the event of estimating that the transmission over it contains errors. The algorithm operates individually, bearer by bearer.

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DESCRIPTION OF A PREFERRED EMBODIMENT

[0019] The present invention is preferentially, but not exclusively, implemented in an asymmetric multi-bearer data communications system based on the DECT standard, comprising at least one transmitting means or transmitter, from
20 which data originated by a service user are sent to at least one receiving means or receiver.
[0020] Nonetheless, it is to be pointed out that in the object of the invention, though not in full compliance with the European "Digital Enhanced Cordless Telecommunications (DECT)" standard, the DECT MAC (medium access control) layer, as defined in the ETS-300175-3 standard, is employed in whole or in part and use is made of the data bearer service termed "MAC MOD-2 protected channel operation (Ip)" defined by the ETSI in said standard.
25 [0021] The transmitter according to the present invention includes and is capable of executing an algorith that permits an estimation to be made of the most probable error situation on the forward bearers. If the situation should arise of the acknowledgement message transmitted on the reverse bearer being absent, for example due to an error on said bearer, the transmitter acts in an intelligent manner, proceeding or not with data retransmission according to the most probable situation estimated by the algorithm.
30 [0022] The algorithm that decides the action to be adopted by the transmitter is termed the estimation algorithm. The estimation algorithm performs the computation of this estimation independently for each forward bearer.
[0023] According to the error situation actually occurred and with the decision taken by the estimation algorithm, four possible cases can arise, which shall be interpreted by the receiver according to the following table:

What actually occurred	What the algorithm estimated (ARQ action)	What the receiver interpreted	DP
Transmission process: MAC-mod2-ACK message sent			
Transmission correct ACK = last frame	Transmission correct	Normal progress	NO
Transmission correct ACK = last frame	Transmission error. Retransmission	Unnecessary retransmission	NO
Transmission incorrect ACK = last frame -1	Transmission correct	Data hop	YES
Transmission incorrect ACK = last frame -1	Transmission error. Retransmission	Retransmission	NO

[0024] In this table:
ACK is the value of the ACK bit of the MAC-mod2-ACK message as is defined in the ETS-300175-3 standard. DP indicates the loss of a data packet termed PDU (protocol data unit).
[0025] As can be seen from the table, there are four possibilities of interaction between the transmitter and the
55 receiver:

- if the transmission has been correct and the estimation algorithm also estimates the transmission was correct, the receiver shall interpret this as a normal progress state without any data item having been lost;

- If other bearers that operate on the same frequency as the evaluated one were recognised as having been received with errors in any of the last N frames. In this case, it is considered the probability of the evaluated bearer that works on the same frequency having failed is also increased. The value of the estimation computation is incremented by means of a series of additions proportional to the number of bearers that operate on the same frequency and that failed in each of the preceding N frames.

- If any other bearers were recognised as having been received with errors in any of the last N frames. In this case it is considered the probability of the bearer having failed is also increased, but to a lesser extent. The value of the estimation computation is incremented by means of a series of additions proportional to the number of bearers that failed in each of the preceding N frames.

- If the bearer was operating on the same frequency as a reverse bearer that has failed in any of the preceding N frames. In this case, it is considered that the probability that the evaluated bearer having failed is also increased. The value of the estimation computation is incremented.

- If the evaluated bearer belongs to the same duplex bearer as a reverse bearer that has failed in any of the preceding N frames. In this case, it is considered the probability of the evaluated bearer having failed is additionally increased. The value of the estimation computation is incremented.

- If the evaluated bearer belongs to the duplex bearer associated with the reverse bearer that has failed in this same frame. In this case it is considered the probability of the evaluated bearer having failed is also increased. The value of the estimation computation is incremented.

[0033]   In this way the forward bearers shall only be retransmitted when the transmitter determines there is a sufficiently high probability that said bearer has failed.

[0034]   Selective retransmission can be used to advantage in the data link control (DLC) layer of the time slots that may have been filtered by error into the estimation process. To this end, a new class of DLC has to be employed, different to those envisaged in the ETS-300175-4 standard with the following characteristics:

- All operations with this alternative option are similar to those of class 1 DLC (defined in clause 14.3.3 of ETS-300175-4) except for the following:

[0035]   The reception of a FU6b frame over channel G_f (refer to clause 12.7.1 of ETS-300175-4) containing the A/N bit of the "receive sequence number" (refer to clause 13.4.3) with value "0", is interpreted as a request for selective retransmission and provokes the retransmission of the protocol data unit (PDU) indicated in bits ER7, ..., ER1 (refer to clause 13.4.3). In this case only this unit (PDU) is retransmitted.

Claims

1. **Method of error estimation in information data transmission** in a communications system in which said data are transmitted by means of data forward bearers from at least one transmitting means to at least one receiving means, **characterised in that** said at least one transmitting means estimates, by means of an estimation algorithm, the most probable error situation in the transmission of the respective data bearers transmitted by said transmitting means, in response to a lack of reception of an acknowledgement message of data reception from each receiving means by means of a bearer in reverse direction, that is, from said receiving means to said transmitting means.

2. **Method** according to claim 1, **characterised in that** in a situation of lack of the acknowledgement message of data reception, the transmitting means retransmits the corresponding bearer in the event that the estimation algorithm determines that there is a sufficiently high probability of said bearer being transmitted erroneously.

3. **Method** according to the preceding claims, **characterised in that** the algorithm operates, with respect to each forward bearer, in an individual manner.

4. **Method** according to any one of the claims 1 to 3, **characterised in that** the transmitting means retransmits a forward bearer if a probability estimation calculated by an algorithm exceeds a certain threshold value.

5. **Method** according to any one of claims 1 to 4, **characterised in that** the calculation of the probability estimation takes the following factors into consideration:

    (a)- if the bearer was recognised as having been received with errors in any of the last N frames;
    (b)- if other bearers that operate on the same frequency as the evaluated one were recognised as having been

9. **Method** according to any one of the claims 1 to 7, <u>**characterised in that**</u> the transmitting and receiving means, although not fully complying with the European "Digital Enhanced Cordless Telecommunications (DECT)" stand-ard, do employ in whole or in part the MAC (medium access control) layer of the DECT, as defined in the standard ETS-300175-3, and make use of the data bearer service termed "MAC MOD-2 protected channel operation (Ip)" defined by the ETSI in said standard.

10. **Method** according to any one of the claims 1 to 8, <u>**characterised in that**</u> selective retransmission is employed at a data link control (DLC) level of the time slots that may have been filtered by error into the estimation process by using a class of the DLC particularly envisaged for this process.

11. **Method** according to claim 10, <u>**characterised in that**</u> the class of the DLC is distinguished from the standard class 1 DLC in the following characteristic:

- the reception of an FU6b frame over an acknowledgement channel G_f, containing an A/N bit of the receive sequence number with value "0" is interpreted as a request for selective retransmission and provokes the retransmission of a protocol data unit (PDU) indicated in bits ER7, ..., ER1.

12. **Transmitter** including a transmitting means for carrying out the method according to any one of claims 1 to 11.